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IS 6219 (1989): Methods of Test for General Purpose Flat Pallets for Through Transit of Goods [TED 12: Freight Containers and Pallets]

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Indian Standard

**METHODS OF TEST FOR GENERAL
PURPOSE FLAT PALLETS FOR THROUGH
TRANSIT OF GOODS**

(Second Revision)

भारतीय मानक

वस्तुओं के परिवहन के लिए सामान्य प्रयोजन के
फ्लैट पैलेटों की परीक्षण पद्धतियाँ

(दूसरा पुनरीक्षण)

UDC 621.869.821 : 620.1

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NEW DELHI 110002

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 24 November 1989, after the draft finalized by the Pallets Sectional Committee, had been approved by the Heavy Mechanical Engineering Division Council.

This standard was first published in 1971 covering test code for non-expendable flat timber pallets only. First revision of this standard was made in 1977 incorporating bending strength test. In the first revision, the tests for metal pallets were also incorporated. The second revision of this standard has been taken up to align it with ISO/DIS 8611 'General purpose flat pallets for through transit of goods — Test methods' issued by the International Organization for Standardization (ISO).

In this revision the procedure for testing of pallets have been modified and three inclined plane tests have also been included.

The tests specified in this standard are particularly appropriate for testing pallet prototypes. They may also be valuable in point-of-manufacture, quality-assurance and field testing of pallets, but it is not intended that these tests be used for research purposes. Tests to establish data for pallet research will normally be considerably more comprehensive than those contained in this standard.

Most pallets are of conventional timber design. The test specified in this standard are, to a large degree, applicable to such pallets. As new designs and materials, particularly plastics, are introduced a pallet which meets the requirements for conventional timber designs may, however, be unfit for use in normal transit by virtue of undesirable properties. In such instances, the inclusion of special tests and special climatic conditioning prior to testing may have to be considered. Extension of the duration of the loading tests may also be desirable.

Suggested levels of performance in relation to the tests specified in this standard are not included but shall be incorporated later.

Indian Standard

METHODS OF TEST FOR GENERAL PURPOSE FLAT PALLETS FOR THROUGH TRANSIT OF GOODS

(Second Revision)

1 SCOPE

1.1 This standard specifies methods of test for general purpose flat pallets for through transit of goods. The tests are principally intended for the evaluation of existing pallets or of new design of pallets in relation to their designed load capacity.

NOTE — The tests may also be of value in

- a) testing individual pallet components;
- b) development of prototype pallets;
- c) research into basic pallet performance (though these tests are not as comprehensive as most research tests require);
- d) evaluation of pallets for in-use-failure situations; and
- e) testing at point of manufacture (unconditioned).

2 REFERENCES

2.1 The Indian Standards given below are necessary adjunct to this standard.

IS No.	Title
3971 : 1976	Glossary of terms on pallets (<i>first revision</i>)
7028 (Part 3) : 1987	Performance test for complete, filled transport packages: Part 3 Horizontal impact tests (horizontal or inclined test; pendulum test) (<i>first revision</i>).

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 3971 : 1976 shall apply.

4 MEASUREMENT AND CHECKING OF TEST PALLETS

4.1 Pallets selected for testing shall be checked to ensure that materials, construction and dimensions conform with any stated specification and deviations shall be noted in the final test report.

4.2 The mass of each pallet shall also be determined and recorded together with the moisture content of the individual components at the time of weighing.

5 SEQUENCE OF TESTING AND NUMBER OF REPLICATES

5.1 When evaluating a pallet in relation to its designed load capacity, a minimum of three replicates shall be tested. The complete sequence of seven tests shall be carried out consecutively in the exact order laid down in this standard.

5.2 For each complete sequence of tests, the same pallet shall be used, including those tests where it is necessary to test the pallet across both of its horizontal axes.

6 CONDITIONING

6.1 Temperature and moisture are known to affect pallets of a number of materials both under test and in the field. Conditioning prior to testing takes account of the reaction of the pallet material to the test environment and ensure valid and repeatable test results.

6.1.1 A further purpose of conditioning is to predict the behaviour of identical pallets in extreme conditions encountered in transit loaded with goods.

6.2 Table 1 includes details of conditioning environments known to be relevant to pallet usage. In accordance with this standard they shall be applied as follows:

- a) Timber pallets (all specimens) shall be conditioned to either environment A or B;
- b) At least one specimen of plastic pallets shall be conditioned to environment C and D; and
- c) At least one specimen of paper-based and wood-based pallets shall be conditioned to environment E or F.

NOTE — Composites consisting of two or more materials may have to undergo more extensive conditioning.

6.3 Where conditioning is relevant and the whole test laboratory cannot be maintained at the required level, then tests shall commence within 1 hour after the pallet has been removed from the conditioning chamber. When environments C and D apply, the tests shall commence immediately after the pallet has been removed from the conditioning chamber. Immediately after each individual test, specimens subjected to environments C or D shall be returned to the conditioning chamber for a minimum of 1 hour.

6.4 For wood-based materials, a record shall be made of the moisture content in each board and stringer at the beginning and on completion of the test sequence.

6.4.1 The moisture content of timber pallets at the time of test shall not exceed 20 percent. If the pallets are outside this range, then the test may proceed provided that the moisture content of boards and stringers are recorded every 24 hour until completion of the test programme.

Table 1 Conditioning Environments
(Clause 6.2)

Conditioning Environment	Atmosphere	Temperature °C	Relative Humidity percent	Time Pallet Hour Material
A	Air	23 ± 2	50 ± 5	1* }
B	Air	20 ± 2	65 ± 5	1* }
C	Air	40 ± 2	—	
D	Air	25 ± 2	—	24 }
E	Air	25 ± 5	90 ± 5	24 to 48* }
F	Water	20 ± 5	—	5 to 24* }
G	Air	—	—	— All metal

*The equilibrium moisture content created in wood-based materials by environments A, B, E and F will depend upon starting conditions, surface area, thickness, species, etc. Appropriate advice shall be sought, if materials are not in approximate equilibrium at time of testing. Instantaneous readings of moisture content may be obtained by the use of a proprietary electrical resistance meter designed for the purpose.

7 ACCURACY OF TEST APPARATUS

7.1 Test apparatus described in **8.1** and **8.2** shall satisfy the following accuracy requirements:

- In the design of the test equipment, the tolerances on all dimensions shall be ±2 percent;
- The accuracy of measurement of the test equipment shall be within ±1 mm;
- The accuracy of positioning of every components, including the load applicators (see Fig. 3), but excluding the test load, shall be ±2 mm;
- The accuracy of positioning of the centre of gravity of the test load, if a dead load, is used, shall be ±20 mm; and
- The total mass of the test loads used shall be within ±3 percent of the predetermined value.

7.2 No part of any test rig shall deflect an amount greater than 2 mm when under maximum test load except in the case of the load applicators as defined in **8.2.2**.

7.3 The inclined plane apparatus shall have rails at 10 ± 1 to the horizontal plane and the efficiency of the dolly and rigidity of the impacting surface shall be as specified in IS 7028 (Part 3) : 1987.

8 STATIC TESTS

8.0 For all static tests described in **8.1** to **8.3**, the test load applied shall include in all cases the mass of any load board and load applicators.

8.1 Stacking Test

The purpose of this test is to determine the compression strength of the pallet or pallet corner block to localized vertical loads.

8.1.1 Deformation Measurements

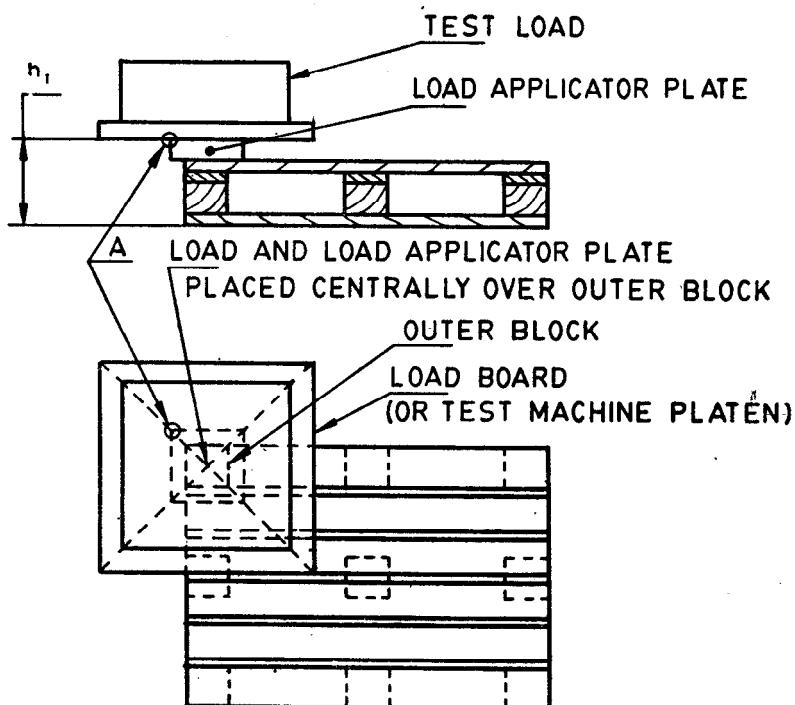
When tested in accordance with the method specified in **8.1.2**, the change in the height, h_1 of the top deck at point A, as shown in Fig. 1, relative to the ground (or test frame) shall be recorded

- at the datum load (see **8.1.2**);
- at the beginning and end of the full load period; and
- upon unloading, at the datum load (see **8.1.2**) every 5 min until successive readings are identical (limited to maximum period of 1 hour).

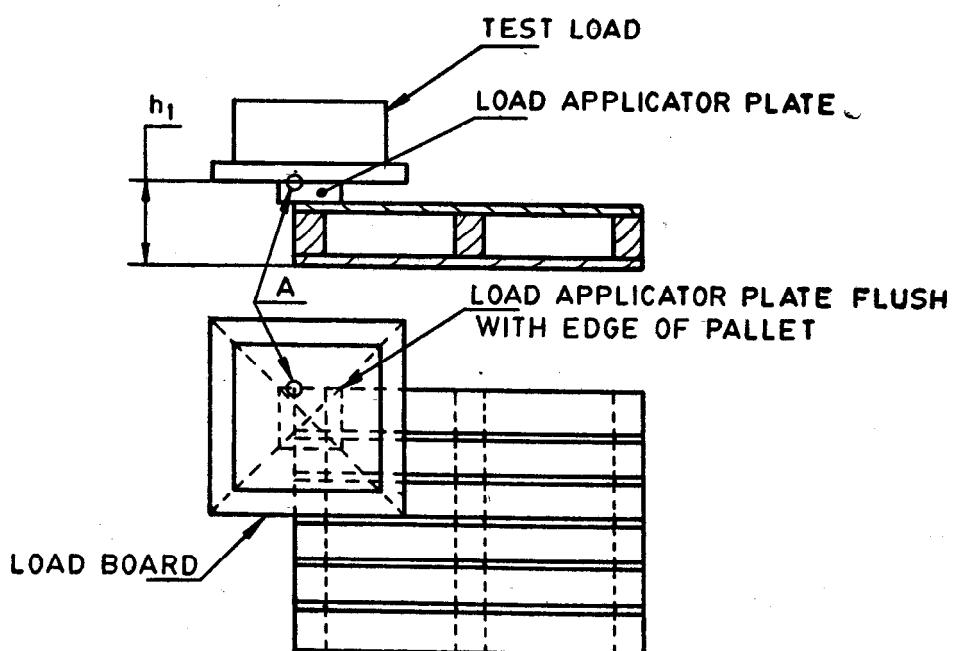
8.1.1.1 Similar measurements shall be made at point B when the test is repeated on the diagonally opposite corner (see **8.1.2**).

8.1.2 Procedure

8.1.2.1 Place the pallet in a normal position on a flat, hard, rigid, horizontal surface. Place a rigid load applicator plate with dimensions of 200 mm × 200 mm × 25 mm, over an outer block (as shown in Fig. 1A) or, in the case of a stringer pallet, over one end of a stringer (as shown in Fig. 1B).



1A Load Applicator Plate Over One Outer Block
(Deflection Measured at Point A)



1B Load Application Plate Over One End of a Stringer
(Deflection Measured at Point A)

FIG. 1 STACKING TEST

8.1.2.2 Gradually apply the test load at a uniform rate from 0 to $0.10R$ where R is the designed load capacity of the pallet, assuming an evenly and uniformly distributed load. This shall be the datum for subsequent deflection measurements. Apply the full test load of $1.10R$, per loaded block for not less than 1 min and not more than 5 min. If deadweight is used for the test load, it shall be symmetrically built up during loading. Keep the full test load in place for a period between 2 and 24 hours depending on the pallet material (see Table 2).

Table 2 Test Load Duration for Static Tests
(*Clauses 8.1.2.2, 8.2.2.3 and 8.3.2.2*)

Pallet Material	Test Period Hour
Timber with metal fasteners	2
Metal	2
Timber and plywood composite	2
Plastics	24
Wood particle board	24
Timber and plastic	24
Composite containing plastic	24
Composite containing adhesive	24

8.1.2.3 Reduce the test load to the datum load for the necessary period [see 8.1.1(c)].

8.1.2.4 Take deflection measurements at point *A* (see 8.1.1).

8.1.2.5 Repeat the test at point *B* (see Fig. 1) so that the test shall have been carried out on two diagonally opposed corners of the pallet. Take a further set of deflection measurements as point *B* (see 8.1.1).

NOTE — Alternatively the test may be carried out on several corners simultaneously with an appropriate increase in full test load (that is $2.20R$ on two corners or $4.40R$ on four corners).

8.1.2.6 Deflection measurements shall then be made at all the corners under test.

8.2 Bending Test

The purpose of this test is to determine the stiffness and flexural strength of the complete pallet.

8.2.1 Deflection Measurements

When tested in accordance with the method specified in 8.2.2, the deflection at points *A* and *B*, as shown in Fig. 2, when measured relative to the upper (or lower surface) of the top or bottom decks and the ground (or test frame), shall be recorded:

- at the datum load (see 8.2.2);
- at the beginning and end of the full load period; and

c) upon unloading, at the datum load (see 8.2.2) every 5 min until successive readings are identical (limited to a maximum period of 1 hour).

8.2.1.1 The distance between the decks, h_2 , directly under the load applicators shall be measured so that data on the minimum fork entry heights under full load can be obtained.

8.2.1.2 Similar measurements shall be made at points *C* and *D* and between the decks when the test is repeated along the second horizontal axis of the pallet (see 8.2.2).

8.2.2 Procedure

8.2.2.1 Place the pallet, top deck uppermost, on square or circular section supports position with their centres 50 mm from the outer edge of the pallet. The load applicators shall be positioned at $0.25 L_1$ when measured as shown from the lines of contact when under load (see Fig. 3), where L_1 is the distance between the contact lines of the pallet supports (see 2).

8.2.2.2 Square or circular section supports shall be sufficiently rigid to ensure that their maximum unsupported centre deflection under load does not exceed 7 mm; the load carriers and supports shall be flush with or project beyond the pallet. Edges shall be relieved with minimum radii as shown in Fig. 3.

8.2.2.3 Gradually apply the test load at a uniform rate from 0 to $0.10R$. This shall be the datum for subsequent deflection measurements. Apply the full test load of $1.25R$ for not less than 1 min and not more than 5 min. If deadweight is used for the test load, it shall be symmetrically built up during loading. Keep the full test load in place for a period between 2 and 24 hours depending on the pallet material (see Table 2).

8.2.2.4 Reduce the test load to the datum load for the necessary period [see 8.2.1 (c)].

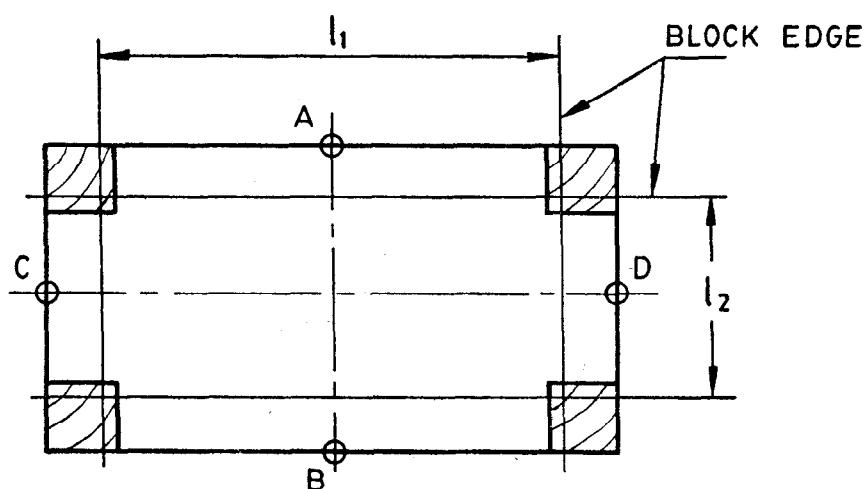
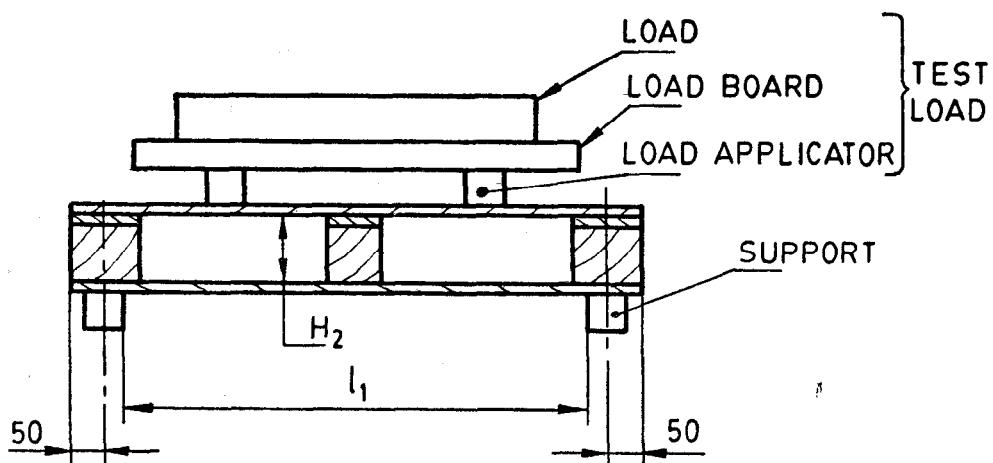
8.2.2.5 Take deflection measurements at points *A* and *B* (see 8.2.1).

8.2.2.6 Repeat the test along the second horizontal axis of the pallet (that is, both length and width are tested) with the load applicators positioned at $0.25 L_2$ when measured as shown from the lines of contact when under load (see Fig. 3), where L_2 is the distance between the contact lines of the pallet supports (see Fig. 2).

8.2.2.7 A further set of deflection measurements shall be taken at points *C* and *D* (see 8.2.1).

8.3 Bottom Deck Test

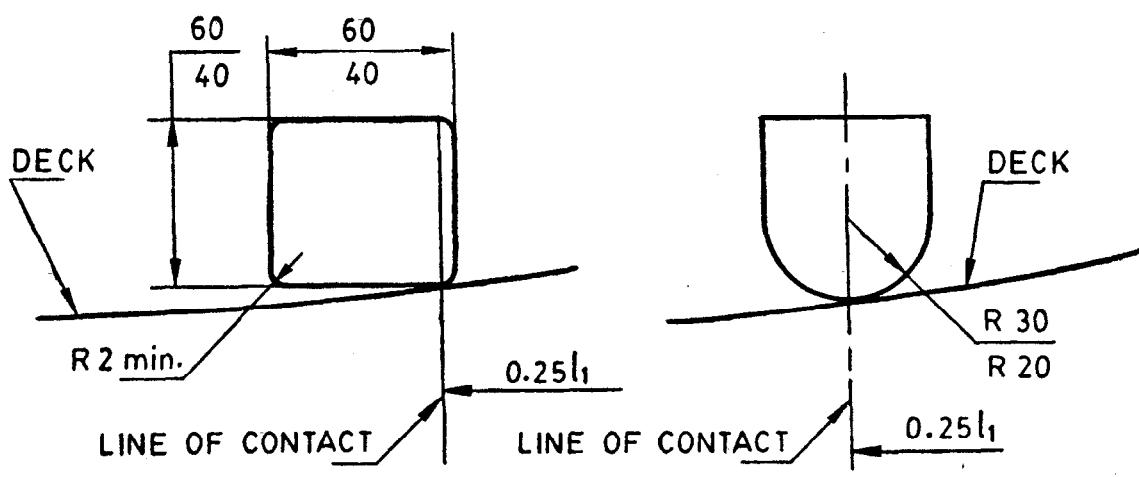
The purpose of this test is to determine the stiffness and flexural strength of the bottom deckboards between support points.



SEE FIG. 3 FOR SUPPORT DETAIL

All dimensions in millimetres.

FIG. 2 BENDING TEST USING SQUARE SUPPORTS AND LOAD APPLICATORS



All dimensions in millimetres.

FIG. 3 ALTERNATIVE PALLET SUPPORTS/LOAD APPLICATORS

8.3.1 Deflection Measurements

When tested in accordance with the method specified in 8.3.2, the deflection at points *A*, *B*, *C* and *D* as shown in Fig. 4, when measured relative to the upper or lower surface of the bottom deck and the ground (or test frame), shall be recorded:

- at the datum load (see 8.3.2);
- at the beginning and end of the full load period; and
- upon unloading, at the datum load (see 8.3.2) every 5 min until successive readings are identical (limited to a maximum period of 1 hour).

8.3.1.1 Similar measurements shall be made at points *E*, *F*, *G* and *H*, as shown in Fig. 4, when the test is repeated on the second horizontal axis of the pallet (see 8.3.2).

8.3.2 Procedure

8.3.2.1 Place the top deck of the pallet so that the centres of the load applicators are midway downwards on a flat, hard, rigid, horizontal surface and place two square or circular section load applicators, as shown in Fig. 3, so that the centres of the load applicators are placed midway between the blocks (that is at $0.5 L_3$) or the stringers (that is $0.5 L_5$). The load applicators shall project over or be flush with the edge of the pallet base and shall be symmetrically placed about the centreline of the pallet.

8.3.2.2 Gradually apply the test load at a uniform rate from 0 to $0.10R$. Apply the full test load of $1.15R$ for not less than 1 min and not more than 5 min. If deadweight is used for the test load, it shall be symmetrically built up during loading. Keep the full test load in place for a period between 2 and 24 hours depending on the pallet materials (see Table 2).

8.3.2.3 Reduce the test load to the datum load for the necessary period (see 8.3.1).

8.3.2.4 Take deflection measurements at points *A*, *B*, *C* and *D* (see 8.3.1).

8.3.2.5 For all except stringer pallets, repeat the test along the second horizontal axis of the pallet (that is both length and width shall be tested) with the centres of the load applicators placed midway between the blocks (that is at $0.5 L_4$) (see Fig. 4).

8.3.2.6 A further set of deflection measurements shall be taken at points *E*, *F*, *G* and *H* (see 8.3.1).

9 IMPACT TESTS

The purpose of impact tests is to simulate normal levels of shock load which are typically transmitted to pallets in through transit and to determine the resistance of the pallet to such loads.

9.1 Incline Plane Tests

These three tests are grouped since they use 10° inclined plane test machine as specified in IS 7028 (Part 3) : 1987.

For all three plane tests, the test load shall be $0.10R$. This test load comprises the load box having a plan size of 600 mm \times 800 mm (see Fig. 5) plus the load in the box, which shall be in contact with the lowest (front) side of the box. The detachable supporting edges shall be at least as long as the pallet under test. The test load shall not include the weight of the dolly. For all three inclined plane tests, the dolly shall be raised up the incline 1 m from the point of impact before release. Each test requires three impacts.

9.1.1 Shear Test

The purpose of this test is to determine the shear resistance between top and bottom decks.

9.1.1.1 Measurements

When tested in accordance with the method specified in 9.1.1.2, the deflection changes *x* and *y* shall be measured between points *A* and *B* and between points *C* and *D* where construction makes this possible (see Fig. 6).

9.1.1.2 Procedure

9.1.1.2.1 Secure a steel or high density hardwood barriers, at least as long as the longer dimension of the pallet, to the face of the backstop. The upper edge of the barrier shall be 15 mm above the bottom surface of the pallet (top surface of the dolly) when the dolly is in its lowest position (see Fig. 7).

9.1.1.2.2 Place the pallet on the dolly of the inclined plane testing machines so that when the forward edge of the pallet is resting against the barrier, the dolly is 75 ± 25 mm clear of it.

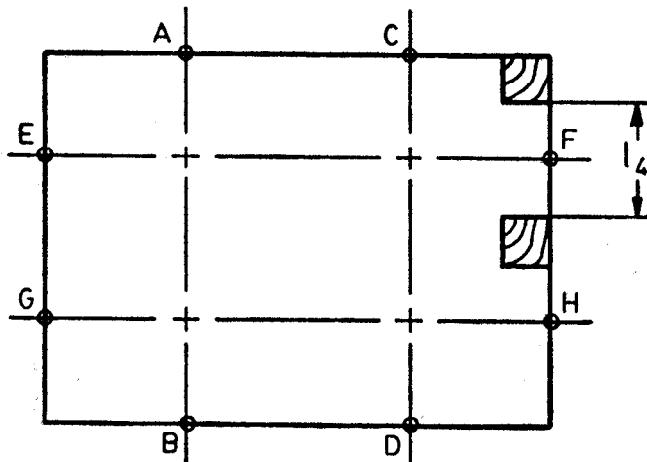
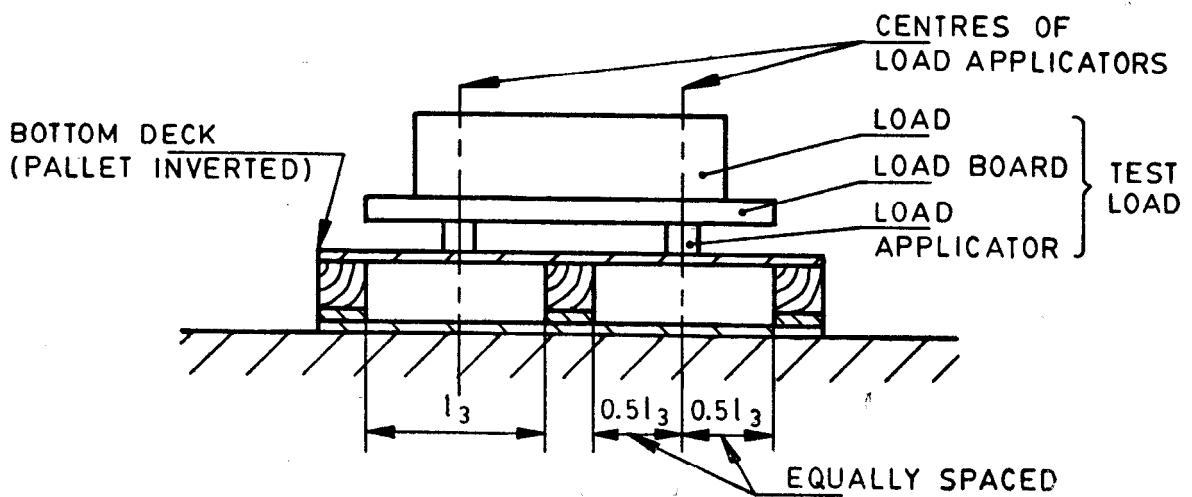
9.1.1.2.3 Attach the load box centrally on the pallet and load uniformly with ballast to $0.10R$ such that loading is central to the axis of movement down the rails.

9.1.1.2.4 Bring the dolly and the loaded pallet to a predetermined position up the incline 1 m from the point of impact, and release. Repeat the procedure twice more, repositioning the pallet, load carrier and load before each impact.

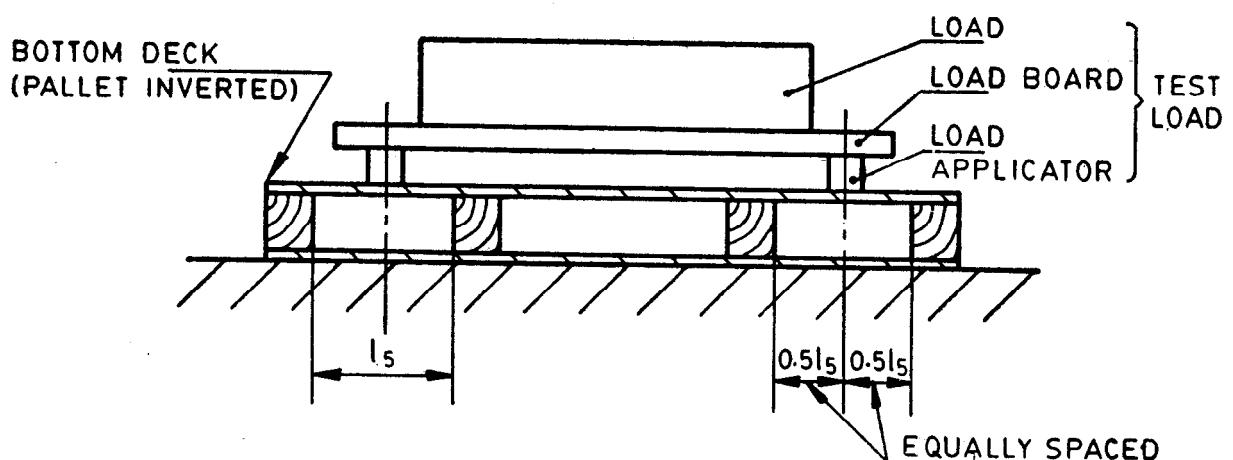
9.1.1.2.5 Carry out a similar sequence of the impacts along the second horizontal axis of the pallet.

9.1.2 Leading Edge Impact Test

The purpose of this test is to determine the shunting resistance of the top leading edge deck-board.

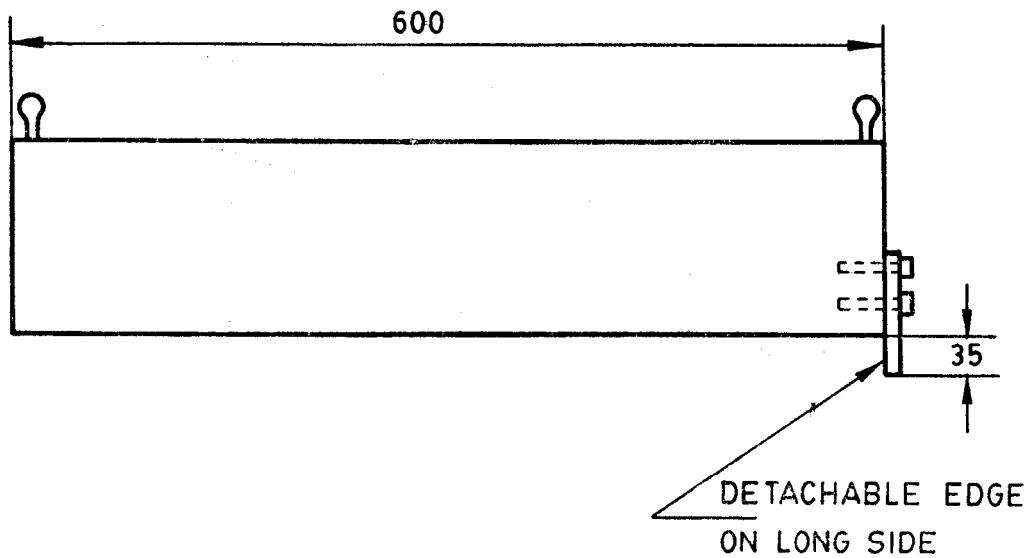


4A Three Stringer Pallet (Two-Way or Partial Four-Way Entry) or Nine-Block Pallet (Four-Way Entry)



4B Four Stringer Pallet

FIG. 4 BOTTOM DECK TEST WITH PALLET INVERTED



All dimensions in millimetres.

FIG. 5 LOAD BOX FOR INCLINED PLANE TEST

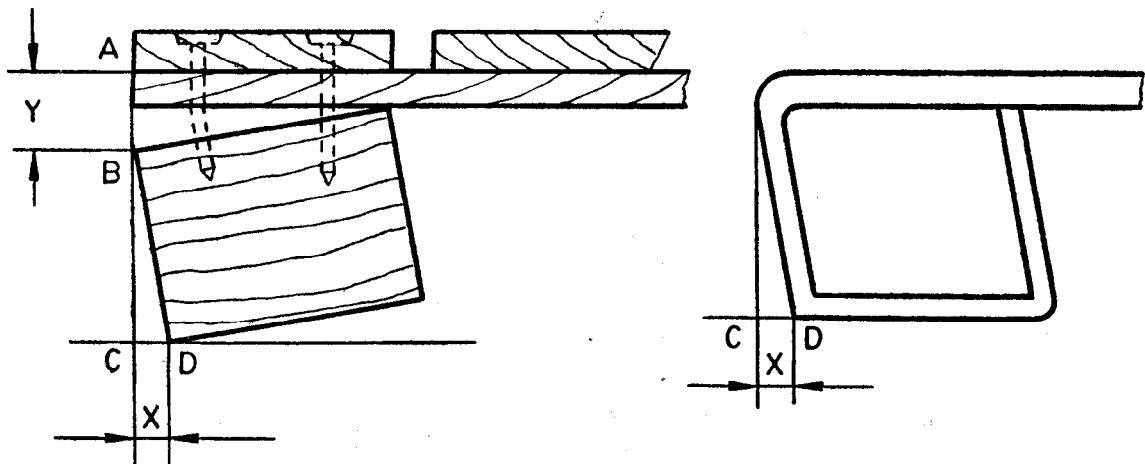


FIG. 6 SHEAR TEST-POINTS OF MEASUREMENTS

9.1.2.1 Measurements

When tested in accordance with the method specified in 9.1.2.2, deformation x and y (see Fig. 8) shall be recorded. The penetration depth and general damage at points of impact shall also be recorded.

9.1.2.2 Procedure

9.1.2.2.1 The inclined plane tester described previously is used with the impact stop shown in Fig. 9.

9.1.2.2.2 Place the pallet and load box loaded to a mass of $0.10R$, on the dolly of the test device, as described in 9.1.1.2 and as shown in Fig. 10.

9.1.2.2.3 The impact stops shall be aligned centrally with the fork openings of the pallet and at a height that allows the leading board to touch the blade top surface at a point between 100 mm

and 250 mm from the shank. The points of impact shall be the same at each impact.

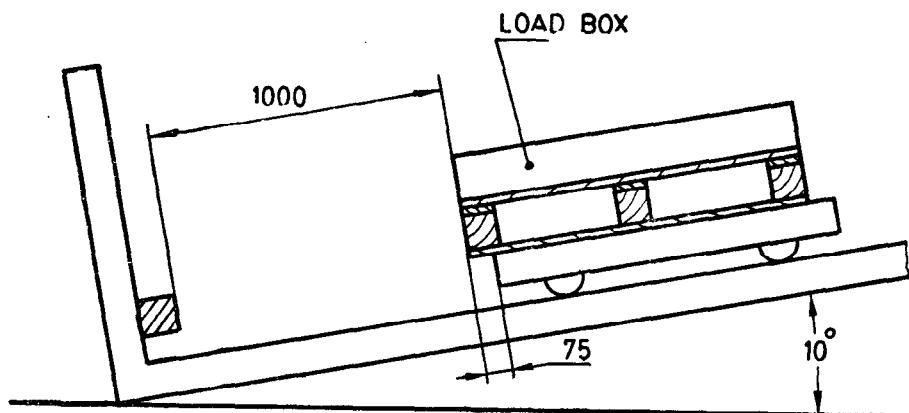
9.1.2.2.4 Raise the dolly and pallet 1 m from the shank so that impact stop contact is made just before the 1 m travel but the true travel before full standstill is 1 m. Release the dolly with the pallet.

9.1.2.2.5 Repeat the procedure twice more, repositioning the pallet, load carrier and load before each impact.

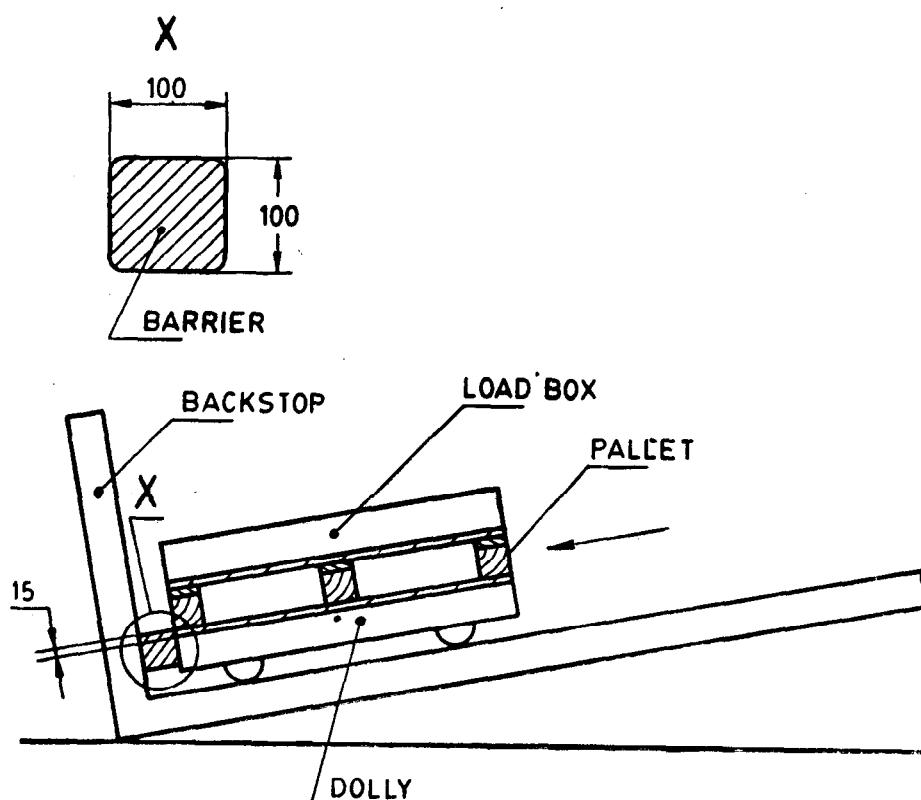
9.1.2.2.6 Carry out a similar sequence of three impacts along the second horizontal axis of the pallet.

9.1.3 Block Impact Test

The purpose of this test is to determine the resistance of pallet blocks to eccentric impacts at the corners.



7A Position Before Release



7B Position at Impact

FIG. 7 INCLINED PLANE SHEAR TEST

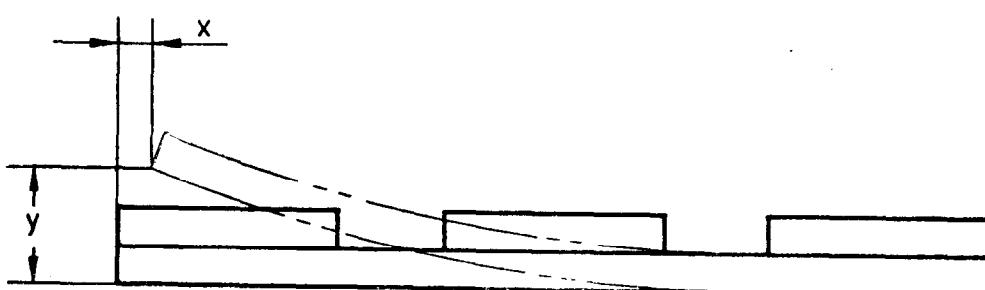
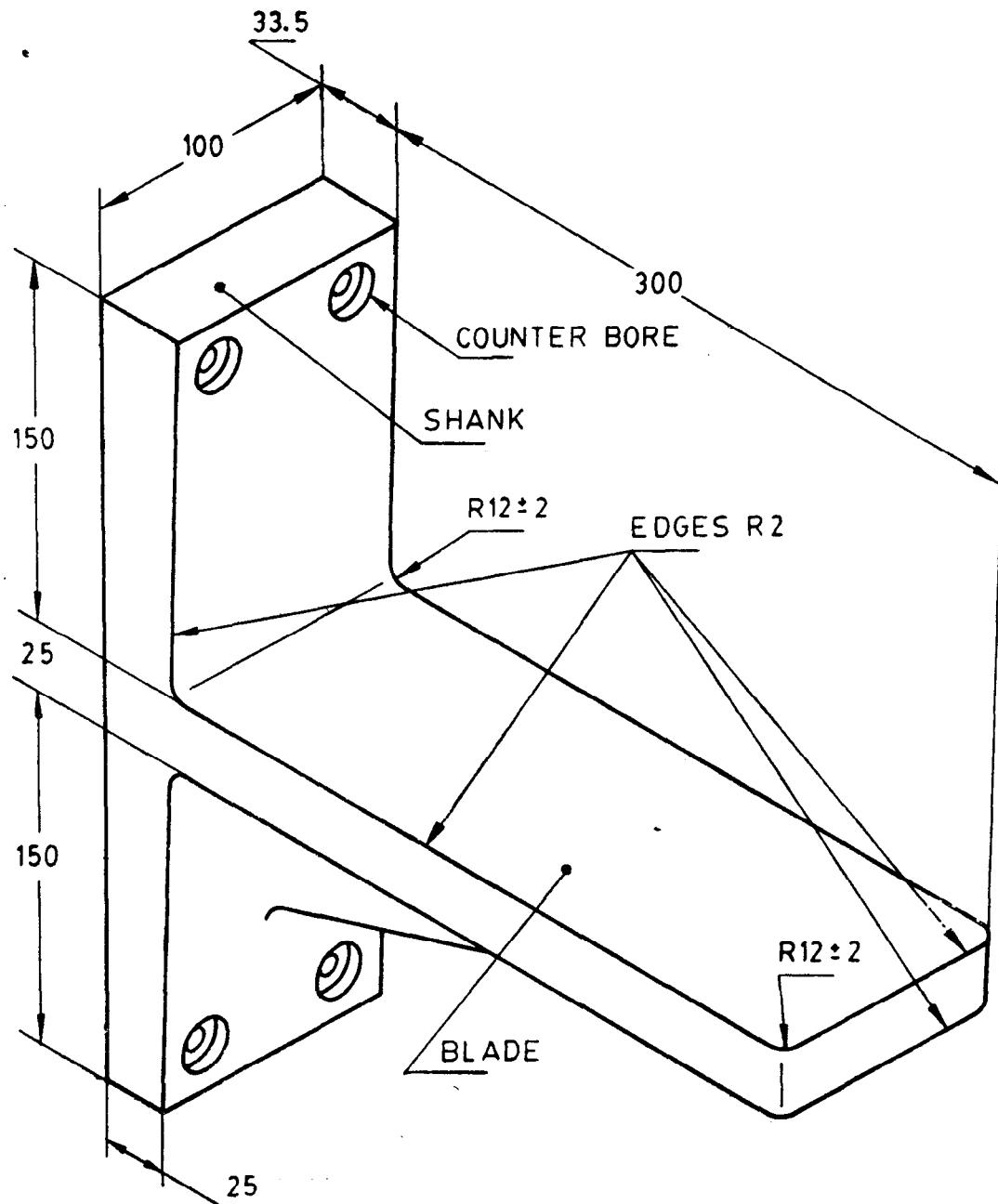


FIG. 8 LEADING EDGE IMPACT TEST-POINTS OF MEASUREMENT



All dimensions in millimetres.

FIG. 9 IMPACT STOP FOR LEADING EDGE AND CORNER IMPACT TEST RIGS

9.1.3.1 Measurements

When tested in accordance with the method specified in 9.1.3.2, the displacement X (see Fig. 11C) of blocks or stringers shall be recorded after each impact together with indentation depth. Notched stringer pallets shall have damage to their notches recorded. Figure 11C shows the positioning differences for rectangular and circular block pallets.

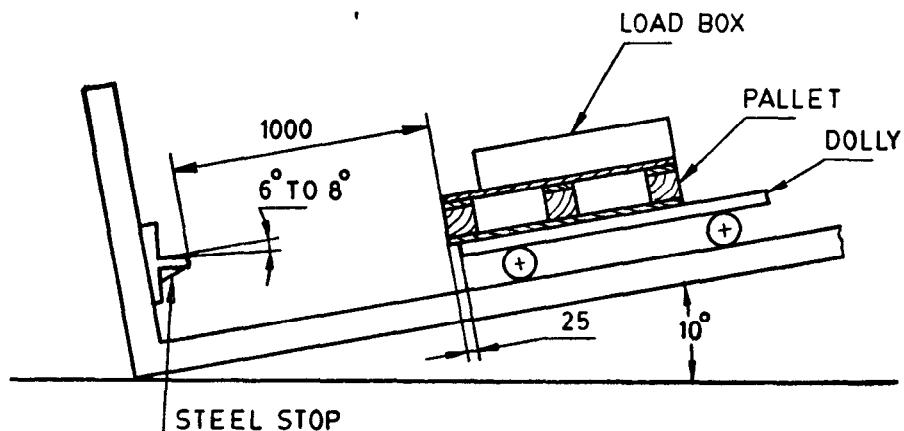
9.1.3.2 Procedure

9.1.3.2.1 The inclined plane tester described previously is used with the impact stop shown in Fig. 9.

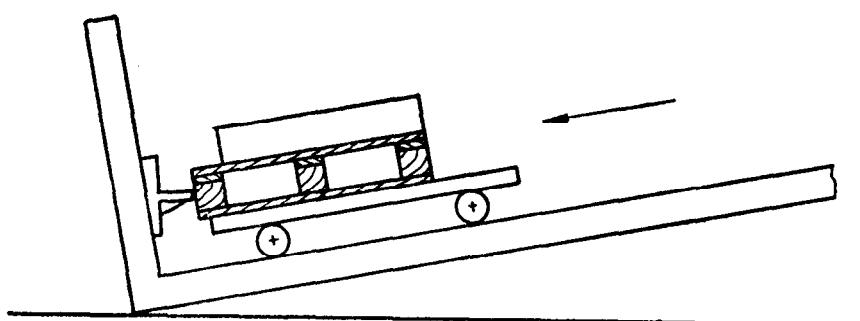
9.1.3.2.2 Place the pallet and load box loaded to a mass of $0.10R$, on the dolly of the test device, as described in 9.1.1.2 and as shown in Fig. 11.

9.1.3.2.3 Place the pallet so that lines parallel with the direction of travel can be drawn from edges A of the impact stops through points on the front face of the stringers of blocks at B as shown. The impact stops shall be positioned accordingly with the top of their leading edge 75 mm above the top surface of the dolly.

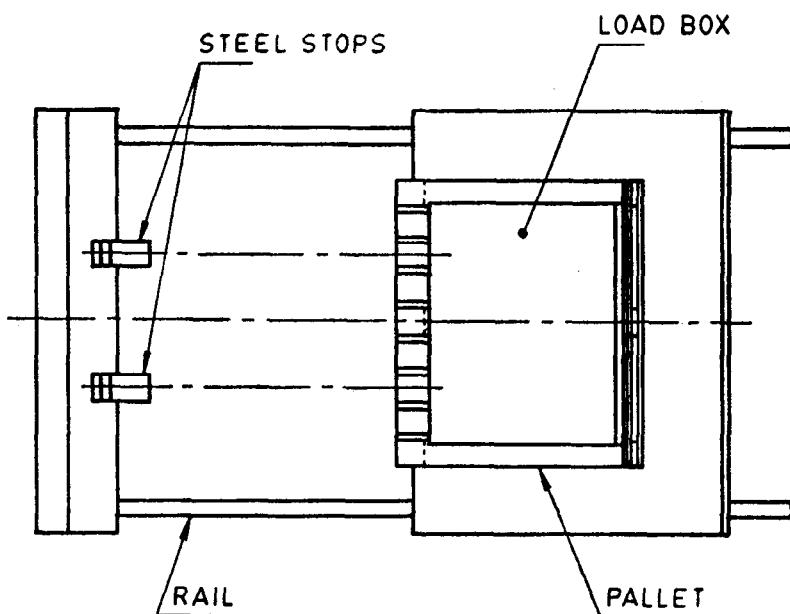
9.1.3.2.4 Raise the dolly and pallet so that they will travel 1 m before impact. Release the dolly with the pallet.



10A Position Before Release

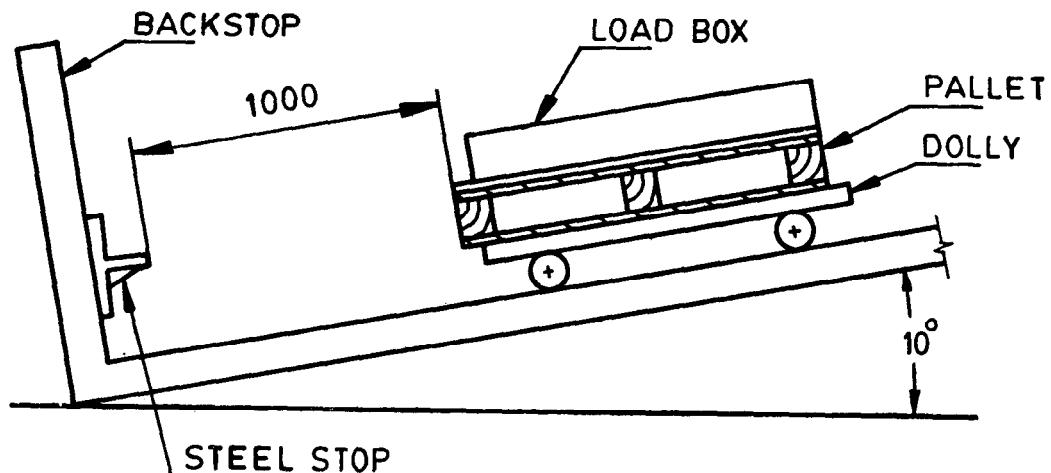


10B Position at Impact

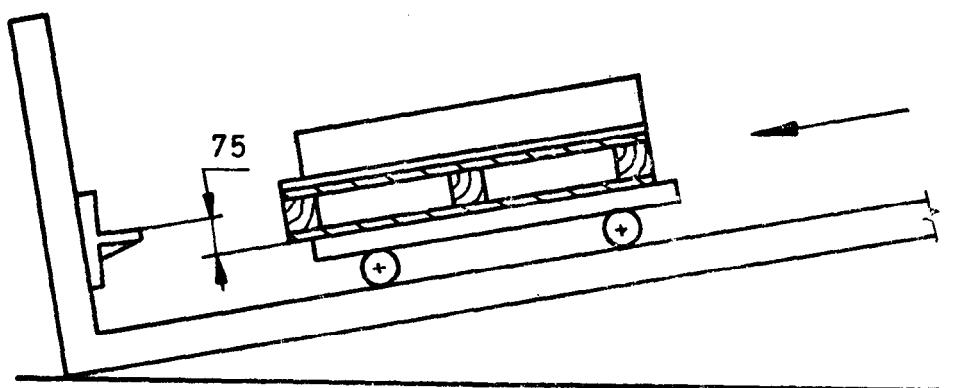


10C Plan View of Position Before Release

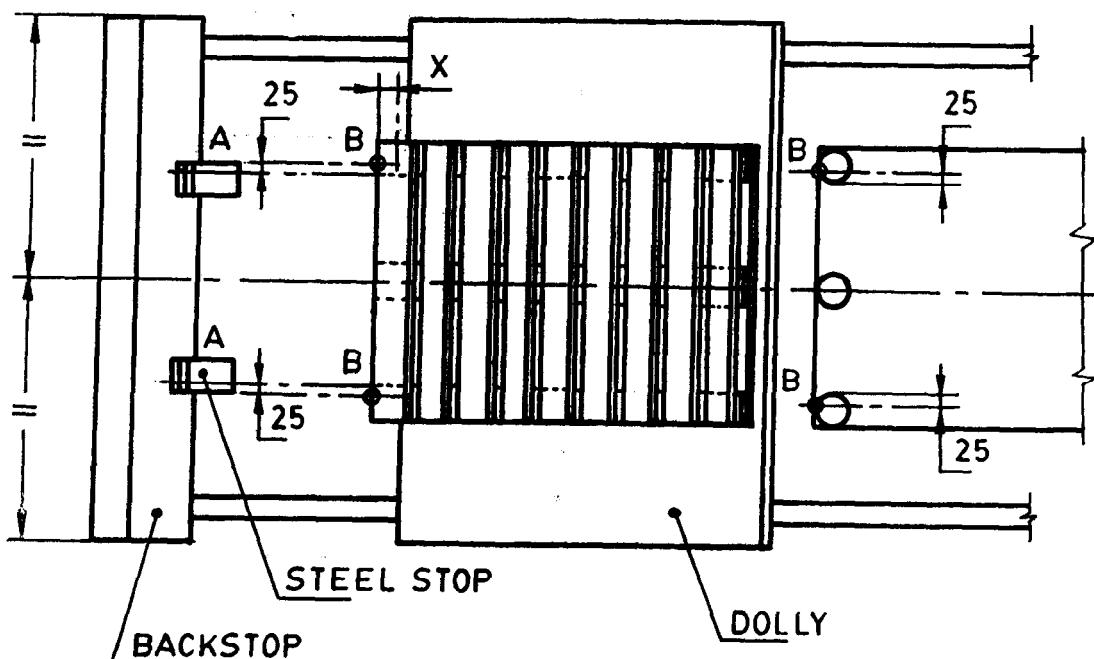
FIG. 10 LEADING EDGE IMPACT TEST RIG



11A Position Before Release



11B Side View Showing Position of Blocks



11C Plan View Showing Position of Blocks

FIG. 11 IMPACT POINTS IN BLOCK IMPACT TEST

9.1.3.2.5 Repeat the procedure twice more, repositioning the pallet, load carrier and load before each impact.

9.1.3.2.6 Carry out a similar sequence of three impacts along the second horizontal axis of the pallet.

9.2 Corner Drop Test

The purpose of this test is to determine the diagonal rigidity of a pallet.

9.2.1 Deformation Measurements

When tested in accordance with the method specified in 9.2.2, the length of diagonal 'Y' (see Fig. 12) shall be measured before the first drop and after the third drop. The measurement shall be taken at the same point in each cycle either when suspended or in the released position after impact. To avoid the effects of local deformation, the points A and B (between which 'Y' is measured) shall each be approximately 40 mm from the respective corners (see Fig. 12).

9.2.2 Procedure

Drop the pallet, with the related diagonal AB vertical, freely on to the corner from a height, H onto a flat, hard, rigid, horizontal impact surface

(see Fig. 12). The drop height, H shall be as stated in Table 3. Carry out the drop three times, always on the same corner and from the same height.

Table 3 Drop Heights for Corner Drop Test
(Clause 9.2.2)

Mass of Pallet, m (kg)	Drop Height, H (m)
$m < 30$	1.0
$m > 30$	0.5

10 TEST REPORT

A test report shall be drawn up and shall include the following information:

- A reference to this standard;
- Any deviations from any stated specification as regards materials, construction and dimensions; and
- The results from the static and impact tests carried out in accordance with the methods specified in 8 and 9 respectively.

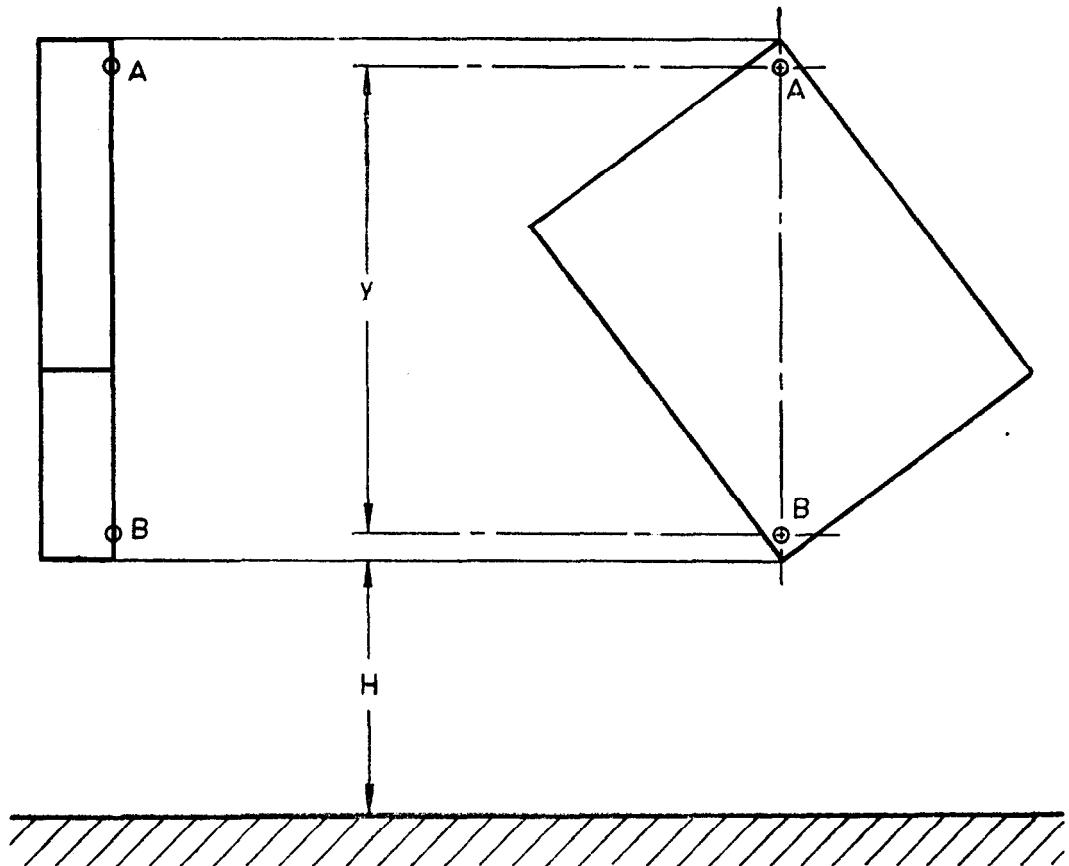


FIG. 12 CORNER DROP TEST

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